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SCIENCE

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OPENING ADDRESS¹

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WE have come together especially to take note of the fact that fifty years ago a number of prominent workers in the field of science founded the National Academy of Sciences, receiving a charter from the United States government. It would be interesting and instructive to call the roll of the founders and learn who they were, but it will suffice to refer to some of the most conspicuous among these or, perhaps it would be better to say, some of those whose names are most familiar to the present generation. High up on this honor list are Louis Agassiz, James D. Dana, Wolcott Gibbs, B. A. Gould, Asa Gray, A. Guyot, Joseph Henry, J. Leidy, J. P. Lesley, Benjamin Peirce, R. E. Rogers, W. B. Rogers, L. M. Rutherford, Benjamin Silliman, Jeffries Wyman and J. D. Whitney. Fifty names are included in the act of incorporation. Among those are several members of the United States Army and Navy, as for example, J. G. Barnard, J. A. Dahlgren, Charles H. Davis, John Rogers, J. G. Totten, and others holding positions in the United States Military Academy and the United States Naval Observatory.

A careful scrutiny of the list of incorporators will show that they can be classified under three heads. The majority were engaged in scientific researches and had reached results of value. They were the leaders among the scientific investigators of that day. Then there were those who had gained distinction by their services as engineers either in the army or navy; and a

¹ Delivered by the president at the anniversary meeting of the National Academy of Sciences, April 22, 1913.

third class was composed of heads of national institutions such as the United States Naval Observatory, Naval Academy, Military Academy and Coast Survey.

Section 2 of the act of incorporation provides that the academy "shall consist of not more than fifty ordinary members," and that the academy "shall have power to make its own organization, including its constitution, by-laws and rules and regulations." Nothing is said in regard to the qualifications for membership. This is equally true of the constitution and rules except that Article I., Section 1, of the constitution requires that "members must be citizens of the United States." It should, however, be noted that Article IV., Section 4, of the constitution contains this clause:

Each nomination shall, at the time of election, be accompanied by a written list of the original works of the nominee.

The reference is to nominations for membership, and the inference is clear that the nominee was assumed to have "original works" to his credit.

Whatever may have been the views of the incorporators, it has gradually come to be held that membership should stand for successful activity in the field of scientific research, the word scientific as here used meaning that which pertains to the natural sciences. But our predecessors did not intend to bind themselves to this meaning, as is clearly shown by the election of James Hadley in 1864, who, though a brilliant scholar, was certainly not distinguished for work in natural sciences; of G. P. Marsh in 1865; and later of Francis A. Walker and Richard Mayo-Smith.

As regards engineers who were prominently recognized in the early days of the academy the change of attitude that is worthy of notice is briefly this: While one who had accomplished some engineering

feat was formerly regarded as worthy of membership by virtue of that fact, now the view appears to prevail that only such engineers as have advanced their subject by original contributions should be recognized.

And, finally, it is no longer held that the heads of scientific bureaus or departments of the United States government should necessarily be made members of the academy, no matter whether they have been actively engaged in scientific research or not. It is evident therefore that the field of choice has gradually become narrower.

What was perhaps regarded as the most important part of the act of incorporation is contained in Section 3 and reads as follows:

The academy shall, whenever called upon by any department of the government, investigate, examine, experiment and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the government of the United States.

This clause is still valid. The United States government may at any time call upon the academy for investigations, opinions and advice on any subject of science or art and this without charge for services.

In order the more clearly to understand the situation that existed in 1863 we should bear in mind two facts. First, there were at that time but few scientific bureaus forming part of the national government; and second, it was a time of war.

Perhaps it would be better to state these facts in the other possible order. Service to the government was uppermost in men's minds. If they could not help in one way, they could in another. What more natural than this willingness to place their knowledge and skill in scientific matters at the disposal of the government? This was an

act of patriotism, and patriotism was in the air. While engineers, astronomers and mathematicians were then well represented in the works of those who were serving their country in one capacity or another, it was a difficult matter for those in authority to secure authoritative opinions and advice in other branches of science. There was a gap to be filled. By granting a charter to a group of the leading workers in all branches of science on the terms under consideration the gap was filled in a most satisfactory manner. After that act there could no longer be excuse for not seeking scientific advice whenever it was desired or needed.

How did this work? An examination of the records shows that for a number of years after the National Academy was incorporated the government perpetually called for reports. Six such reports were made in the first year of the existence of the academy. The subjects were: "On the Protection of the Bottoms of Iron Vessels"; "On the Magnetic Deviations in Iron Ships"; "On an Alcoholometer"; "On the Explosion of the Boiler of the United States Steamer *Chenango*"; "On the Use of Aluminium Bronze for Cent Coinage"; "On Wind and Current Charts and Sailing Directions." In 1865 there were two reports; in 1866, four; in 1867, two, both of which are worthy of special mention. They are "On the Improvement of Greytown Harbor, Nicaragua," and "On Galvanic Action from Association of Iron and Zinc." In 1868 there were two. In 1870 there was one report "On the Protection of Coal Mines from Explosions by Electricity"; another "On Removal of Ink from Revenue Stamps"; and a third "On Silk Culture in the United States." In 1875 and 1876 there was only one each. Then in 1878 there were several important reports—six in all—among them one "On

Proposed Changes in the Nautical Almanac"; another "On the Use of Polarized Light for Determining Values of Sugars"; another "On the Measurement of the Velocity of Light" and another "On the Preservation of the Writing of the Original Declaration of Independence." While there have been important reports on important subjects since 1878, it is undoubtedly true that of late years the academy has been called upon less frequently than in the early years. At first the officers of the national government took the matter seriously, and this was to the advantage of the country. But with the multiplication of scientific bureaus supported by the government the need of help from the academy has become less and it is true that some of the subjects already mentioned, and others not mentioned, could have been reported upon by one or another of the existing bureaus had they been in existence at the time. But, even as matters now stand, there is ample room for the kind of activity which was in the minds of the founders. Large questions of a scientific character present themselves from time to time, and it is hard to conceive of a better method of dealing with such questions than that under consideration. In this connection it should be borne in mind that advice, even good advice, is not always heeded. Indeed it may happen that it is treated almost contemptuously. This is well illustrated by an actual case which deals with an important governmental problem. Owing to its importance this case may well be treated of in some detail.

The sundry civil act, approved May 27, 1908, requests the National Academy of Sciences to consider certain questions relating to the conduct of the scientific work under the United States government, and to report the result of its investigations to Congress. In order that the subject may

be clearly understood the language of Section 8 of the act referred to should be quoted:

Sec. 8. The National Academy of Sciences is required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character and all chemical, testing and experimental laboratories and to report to Congress as soon thereafter as may be practicable a plan for consolidating such surveys, chemical, testing and experimental laboratories, so as to effectually prevent duplication of work and reduce expenditures without detriment to the public service.

A committee was promptly appointed and that committee gave serious and prolonged attention to the subject. In due time the committee submitted its report to the council of the academy. The council having approved, the president transmitted the report to the Speaker of the House of Representatives and the presiding officer of the Senate. Everything was done in proper form. The president of the academy congratulated himself on the personnel of the committee which he had appointed, upon the report and upon the fact that the academy had performed an important duty and had been, as he thought, of real service to the national government.

It were well perhaps to close the account of the incident at this point, but unfortunately the moral would be lost, and the only object of telling the story at all is to point the moral. Well, what happened next? It is not necessary to go into detail. The result was humiliating to the committee that drew up the report. That report seems to have been promptly pigeonholed. It is certain that, so far as we have any information on the subject, it was not given serious consideration by Congress. And yet whatever may have been its imperfections that report represented the views of a group of eminent men of science who had devoted much time and thought to the

study of the problem before them and who at the request of the President of the United States had been given every opportunity to learn the facts. Such an experience need not dishearten. The charter still holds good, and accordingly, the academy stands ready, whenever called upon by "any department of the government," to "investigate, examine, experiment and report upon any subject of science or art." As time passes it will come to be recognized more and more clearly by those in authority that the scientific method is the one most likely to lead to results of permanent value. Briefly defined, the scientific method consists in studying the facts and then drawing the most logical conclusion from these facts. It is most desirable that our government should utilize to a greater and greater extent this method which is free from partisanship and has only truth to serve. In the long run the influence of the National Academy upon affairs of government must be felt. Far-sighted statesmen must see and do see that it is well for the country to have a body of workers in the field of science connected in some way with the government, and the day will come when this will be recognized more clearly and more generally than it is to-day. The question is not what is best for the academy? It is, what is best for the country? May we not hope that in the near future Congress will see its way clear to emphasize the importance of the connection between the government and the academy by providing it with a proper home which can serve as a center of general scientific activity? This subject has again recently been brought to the front and there is a possibility that favorable action may be taken.

By an act of Congress approved June 20, 1884, the National Academy of Sciences was "authorized and empowered to receive

bequests and donations and hold the same in trust, to be applied by the said academy in aid of scientific investigations and according to the will of the donors."

The funds under the general management of the academy and their purposes will now be stated in their chronological order.

1. *The A. D. Bache Fund*.—This amounts to over \$50,000. It was provided by the will of Alexander Dallas Bache, one of the charter members and the first president of the academy, who was for many years superintendent of the United States Coast Survey. The academy is trustee, and the income is applied to the prosecution of researches in physical and natural sciences.

2. *The Joseph Henry Fund*.—This fund of \$40,000 was contributed by a number of friends and admirers "as an expression of the donors' respect and esteem for Professor Joseph Henry's personal virtues, their sense of his life's great devotion to science with its results of important discoveries and of his constant labors to increase and diffuse knowledge and promote the welfare of mankind." The income was to be paid to Professor Henry during his life, and after his death to his wife and daughters, and after the death of the last survivor the fund is to be delivered to the National Academy of Sciences, "the principal to be forever held intact and the income to be from time to time applied by the said National Academy of Sciences in its sole discretion to assist meritorious investigators, especially in the direction of original research." Happily this fund has not yet come into the possession of the academy. It is not necessary to remind this audience that Professor Henry was for years the secretary of the Smithsonian Institution.

3. *The J. C. Watson Fund*.—This amounts to \$25,000, and was provided by the will of

Professor J. C. Watson, a distinguished member of the academy, who died in 1880. The income "shall be expended by said academy for the promotion of astronomical science." It is also provided "that the academy may, if it shall seem proper, provide for a gold medal of the value of one hundred dollars, from time to time to the person in any country who shall make any astronomical discovery or produce any astronomical work worthy of special reward as contributing to our science." Five medals have thus far been awarded, the recipients being B. A. Gould, Edward Schönfeld, Arthur Auwers, Seth C. Chandler and Sir David Gill.

4. *The Henry Draper Fund*.—In 1883 Mrs. Henry Draper, widow of Henry Draper, late our honored member, presented to the academy a fund of \$6,000 for the establishment of a gold medal to be awarded by the academy every two years to the individual in this or any other country who makes the most important discovery in astronomical physics. This fund now amounts to \$10,000, as, in accordance with the wish of the donor, the income, above what was required to provide the Draper medals, was for a time allowed to accumulate and was added to the principal until this amounted to \$10,000. At present the excess of income is available for purposes of research in the line of astronomical physics. The Draper medallists named in chronological order are S. P. Langley, E. C. Pickering, H. A. Rowland, H. K. Vogel, J. E. Keeler, Sir William Huggins, G. E. Hale and C. G. Abbot.

5. *The J. Lawrence Smith Fund*.—In 1884 Mrs. J. Lawrence Smith, widow of one of our honored members, presented to the academy the sum of \$8,000, the object of the gift being to promote the study of meteoric bodies, a branch of science which Dr. Smith had pursued with marked suc-

cess. In accordance with the wishes of the donor it was decided that a gold medal to be given as a reward for original investigations would be most appropriate. Any excess of income above what is necessary for the striking of the medal "shall be used in such manner as shall be selected by the National Academy of Sciences in aid of investigations of meteoric bodies to be made and carried on by a citizen or citizens of the United States of America." Only one J. Lawrence Smith medal has been awarded. The recipient was H. A. Newton, "for the investigation of the orbits of meteors." The income has otherwise been used to aid investigations, especially those of Professor Newton.

6. *The F. A. P. Barnard Medal*.—This was provided for by the will of the late F. A. P. Barnard, one of the incorporators of the academy, and, at the time of his death the president of Columbia College (now Columbia University). The fund is controlled by the trustees of Columbia University. They "shall cause to be struck, with suitable devices, a medal of gold, nine tenths fine, of the bullion value of not less than two hundred dollars, to be styled 'The Barnard Medal for Meritorious Services to Science,' and shall publicly announce that a copy of the same shall be awarded, at the close of every quinquennial period . . . to such person, whether a citizen of the United States or of any other country, as shall, within the five years next preceding, have made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as, in the judgment of the National Academy of Sciences of the United States, shall be esteemed most worthy of such honor." In accordance with these terms the academy has recommended to the trustees of Columbia University the award of the Barnard medal as follows:

In 1895 to Lord Rayleigh and William Ramsay "for their brilliant discovery of argon, a discovery which illustrates so completely the value of exact scientific methods in the investigation of the physical properties of matter."

In 1900 to Wilhelm Conrad Röntgen, "for his discovery of the X-rays."

In 1905 to Henri Becquerel "for his discoveries in the field of radioactivity."

In 1910 to Ernest Rutherford "for meritorious services to science resulting especially from his investigations of the phenomena of radioactive materials."

7. *The Wolcott Gibbs Fund*.—When Wolcott Gibbs, who was one of the incorporators of the academy and at one time its honored president, reached the age of seventy in 1892 a number of friends presented him \$2,600 to establish a fund bearing his name, the income to be devoted to aiding in the prosecution of chemical research. Dr. Gibbs presented this fund to the academy, the income to be administered by a board of directors, who "shall have absolute and entire control of the disposition of the income of the fund, employing it in such manner as they may deem for the best interest of chemical science."

8. *The Benjamin Apthorp Gould Fund*.—In 1897 Miss Alice Bache Gould, daughter of the distinguished astronomer, Benjamin Apthorp Gould, one of the incorporators of the academy, who died in 1896, presented to the academy the sum of \$20,000 as a memorial of the life work of her father, the income to be used "for the prosecution of researches in astronomy."

9. *The Cyrus B. Comstock Fund*.—This now amounts to something over \$10,000 and is to be increased by accumulations of income until it reaches \$15,000. A part of the income is to be used to provide "once for every five years a prize in money to the bona fide resident of North America, who,

not less than one year nor more than six years before the awarding of the prize, shall have made in the judgment of the trustees the most important discovery or investigation in electricity or magnetism or radiant energy."

This gift was received in December, 1907, and the first Comstock prize will be awarded at the present meeting.

General Comstock was a distinguished engineer, and a member of the academy. He died in 1910.

10. *The O. C. Marsh Fund*.—Professor Marsh, for twelve years president of the academy, died in 1899. He bequeathed the sum of \$10,000 to the academy, "the income to be used and expended by it for promoting original research in the natural sciences." This fund has not yet become available.

11. *The Alexander Agassiz Fund*.—Alexander Agassiz, who was president of the academy from 1901 to 1907, died in 1910, and bequeathed to the academy the sum of \$50,000 unconditionally. No decision has yet been reached in regard to the uses to which this fund is to be put.

12. *The Agassiz Medal*, which will be awarded for the first time this year, was provided for by a gift of Sir John Murray.

While this account may have proved tedious to some of you, it seemed necessary for the purpose of giving a correct impression of the work now being carried on. The academy has sacred duties to perform. It will soon devolve upon the younger members to see that these duties are conscientiously performed.

The constitution provides that the academy shall hold one meeting in each year in the city of Washington and another at such place and time as the council may determine. Whatever may be said of the duties of the academy as the scientific adviser of the government and as a custodian of trust

funds, it must be acknowledged that it is through the agency of its regular meetings that its influence is mainly exerted. In this as in other matters, it is the subtle, the intangible, the spiritual that tells. Workers in the field of science are supposed by some, perhaps by many, to be incapable of recognizing the force of the intangible, and yet scientific work must inevitably lead to this recognition. It is impossible to weigh and measure the effect of the meetings upon those who take part. But that effect is felt none the less, and it is certain that those who attend are in the long run benefited—some in one way, some in another. This is not a subject that lends itself to profitable discussion. It may not be out of place, however, for one who has been a regular attendant for over thirty years to make public acknowledgment of the debt which he personally owes the academy for the opportunities it has afforded him of associating with and counting among his friends those whose earnest, honest work has been an inspiration to him and to the world. This association has been an inestimable privilege for which he is deeply thankful.

The work of the academy will continue; new and younger members will take up the work. Is it too much to hope that when the centennial anniversary is celebrated some of the members here present may be remembered as we to-day remember with gratitude the founders?

IRA REMSEN

THE RELATION OF SCIENCE TO HIGHER EDUCATION IN AMERICA¹

THE half century which has elapsed since the founding of this academy has witnessed a radical change in the relations

¹ Address delivered before the National Academy of Sciences on the occasion of the semi-centennial celebration of its foundation.